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**Coffey et al.**

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(54) <b>TELECOMMUNICATIONS CABINET MODULARIZATION</b>	(56) <b>References Cited</b>
	U.S. PATENT DOCUMENTS
(71) Applicants: <b>ADC Telecommunications, Inc.</b> , Berwyn, PA (US); <b>Tyco Electronics Corporation</b> , Berwyn, PA (US)	2,773,940 A * 12/1956 Lebedinsky ..... 370/200
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( * ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.	5,175,673 A * 12/1992 Roger et al. .... 361/818
(21) Appl. No.: <b>13/939,407</b>	5,323,454 A * 6/1994 Shay et al. .... 379/327
(22) Filed: <b>Jul. 11, 2013</b>	5,448,675 A * 9/1995 Leone et al. .... 385/135
(65) <b>Prior Publication Data</b>	5,461,693 A * 10/1995 Pimpinella ..... 385/135
US 2014/0016903 A1 Jan. 16, 2014	5,566,836 A * 10/1996 Lerman ..... 211/26
	5,659,648 A * 8/1997 Knapp et al. .... 385/129
	5,712,942 A * 1/1998 Jennings et al. .... 385/134
	5,793,909 A * 8/1998 Leone et al. .... 385/24
	5,901,033 A * 5/1999 Crawford et al. .... 361/600
	6,175,079 B1 * 1/2001 Johnston et al. .... 174/50
	6,215,938 B1 4/2001 Reitmeier et al.
	6,487,356 B1 * 11/2002 Harrison et al. .... 385/135
	6,489,565 B1 * 12/2002 Krietzman et al. .... 174/101
	6,587,630 B2 * 7/2003 Spence et al. .... 385/134
	6,616,344 B1 * 9/2003 Van Deventer ..... 385/88
	6,760,531 B1 * 7/2004 Solheid et al. .... 385/135
	6,870,095 B1 * 3/2005 Whitted ..... 174/481
	6,885,564 B2 * 4/2005 Hockett ..... 361/796
	7,142,764 B2 11/2006 Allen et al.
	7,188,415 B2 * 3/2007 Robinson et al. .... 29/868
	(Continued)
	OTHER PUBLICATIONS
	Wikipedia, Kapton, Sep. 3, 2014, 4 pages.
	(Continued)
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**G02B 6/44** (2006.01)

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CPC ..... **G02B 6/444** (2013.01); **G02B 6/4452** (2013.01)

(58) **Field of Classification Search**  
CPC ..... G02B 6/444; G02B 6/4452  
USPC ..... 385/100, 135  
See application file for complete search history.

(57) **ABSTRACT**

An example telecommunications cabinet includes: an enclosure including sidewalls extending between a bottom of the enclosure and a top of the enclosure to define an interior of the enclosure; telecommunications equipment disposed within the interior of the enclosure; and a data distribution arrangement disposed on one of the sidewalls within the interior of the enclosure.

18 Claims, 8 Drawing Sheets

(56)

**References Cited**

## U.S. PATENT DOCUMENTS

7,233,731	B2	6/2007	Solheid et al.	
7,315,681	B2 *	1/2008	Kewitsch	385/135
7,439,449	B1 *	10/2008	Kumar et al.	174/254
7,760,516	B2 *	7/2010	Johnson, Jr. et al.	361/826
8,014,171	B2 *	9/2011	Kelly et al.	361/826
8,410,364	B2 *	4/2013	Dunwoody et al.	174/68.1
8,576,580	B2 *	11/2013	Kelly et al.	361/826
2003/0194187	A1 *	10/2003	Simmons et al.	385/53
2004/0114326	A1	6/2004	Dodgen et al.	
2005/0029004	A1 *	2/2005	Robinson et al.	174/72 A
2005/0220393	A1	10/2005	Riester et al.	
2007/0036506	A1 *	2/2007	Kewitsch	385/135
2007/0230148	A1 *	10/2007	Campini et al.	361/788
2008/0151524	A1 *	6/2008	Kelly et al.	361/826
2008/0247723	A1	10/2008	Herzog et al.	

2009/0236117	A1 *	9/2009	Garza et al.	174/100
2009/0245743	A1 *	10/2009	Cote et al.	385/135
2009/0283488	A1 *	11/2009	McMillan et al.	211/183
2010/0006317	A1 *	1/2010	Hruby et al.	174/97
2010/0027953	A1 *	2/2010	Russell	385/135
2011/0044020	A1	2/2011	Hruby et al.	
2011/0192631	A1 *	8/2011	Burek et al.	174/101
2011/0286198	A1 *	11/2011	Kelly et al.	361/826
2012/0019177	A1 *	1/2012	Kaufmann et al.	318/379

## OTHER PUBLICATIONS

Commscope, Cabling Solutions/Patching Solutions, InstaPATCH® Plus & G2 Solutions, May 18, 2012 (as cached on [www.archive.org](http://www.archive.org)), 2 pages.

ADC, TE connectivity, Quareo Physical Layer Management, Copyright 2014, 2 pages.

\* cited by examiner

FIG. 1

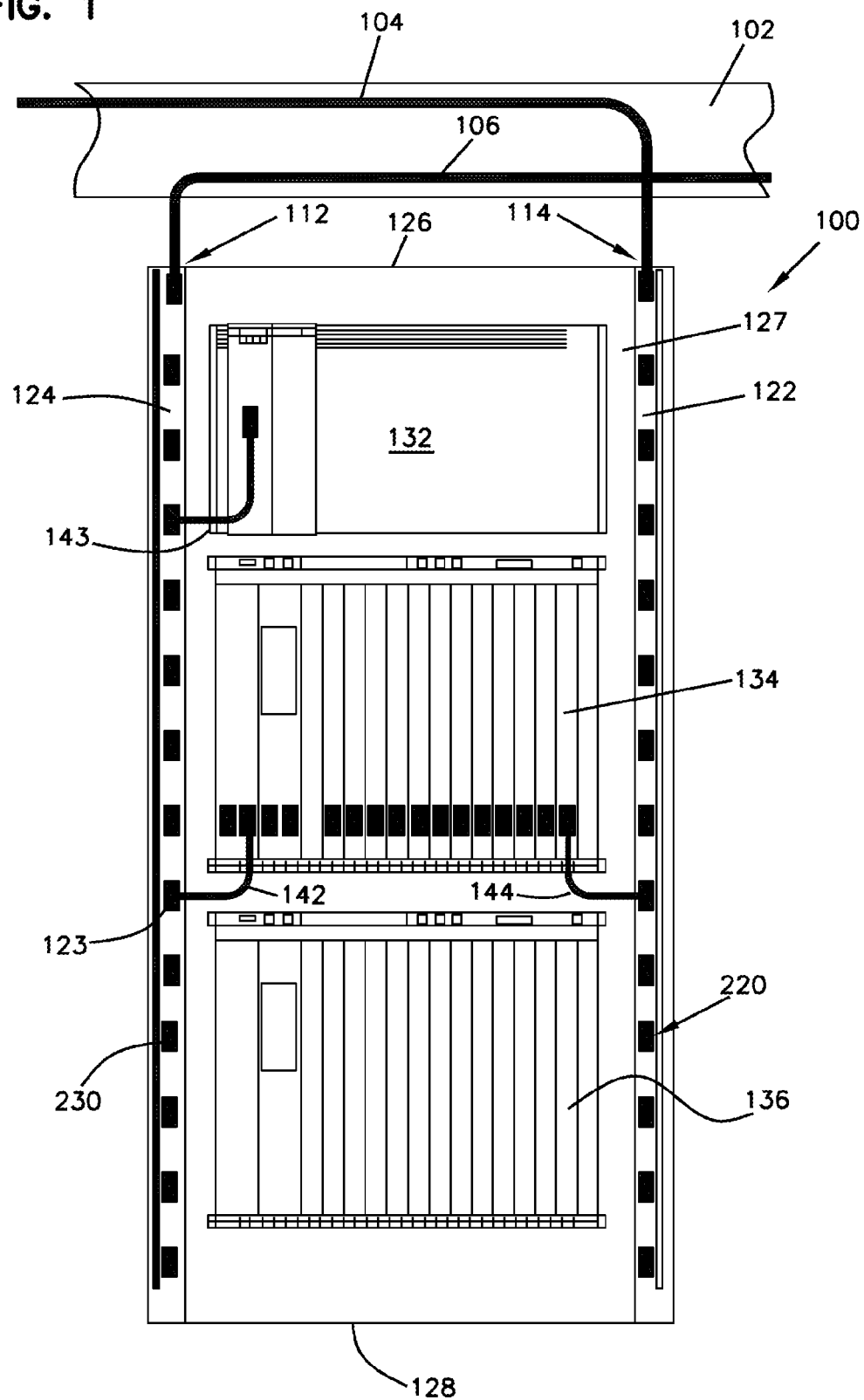


FIG. 2

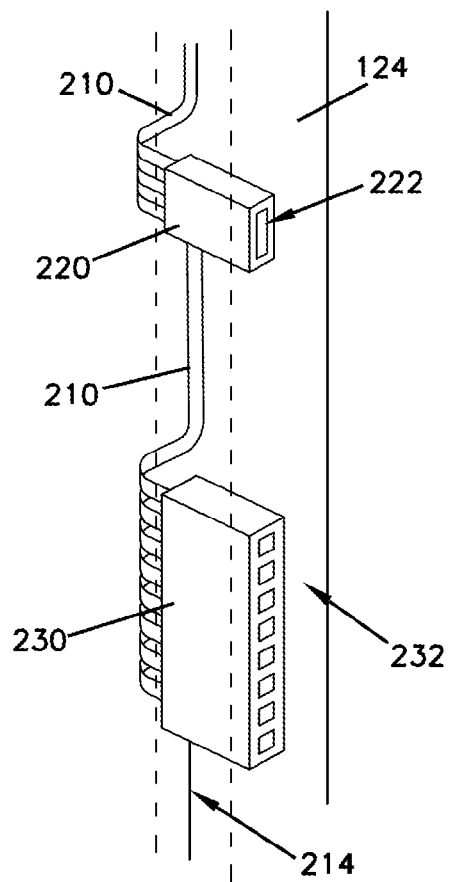
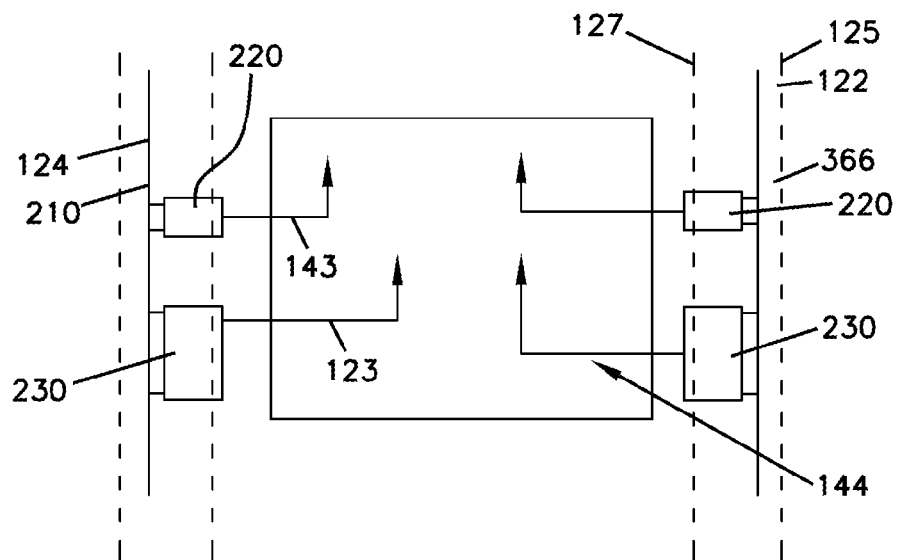
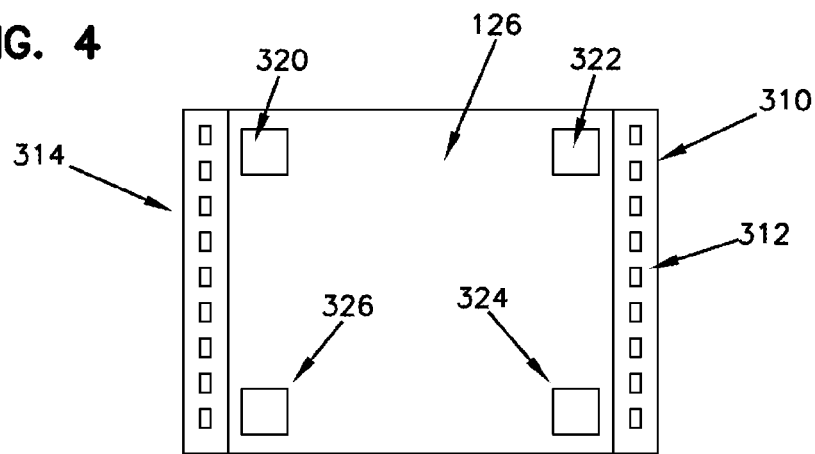


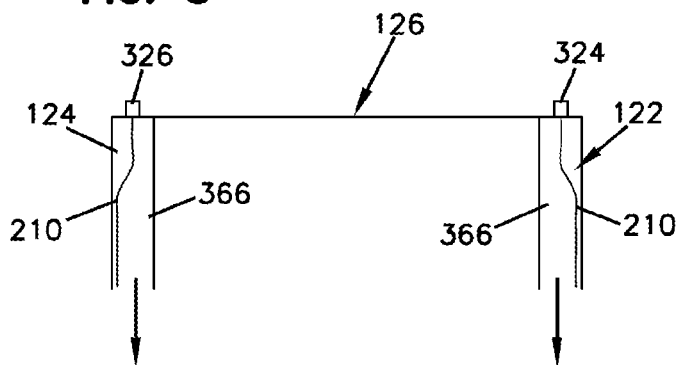
FIG. 3



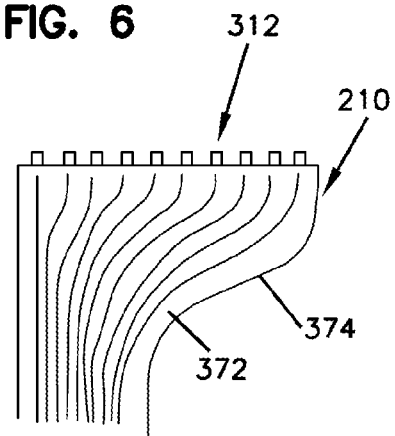
**FIG. 4**



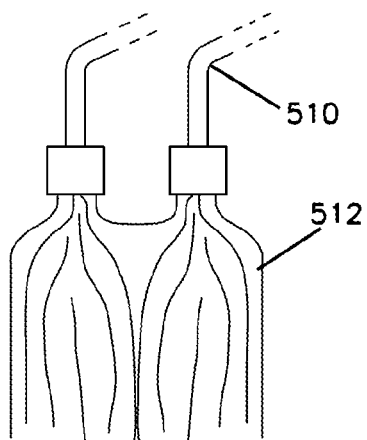
**FIG. 5**



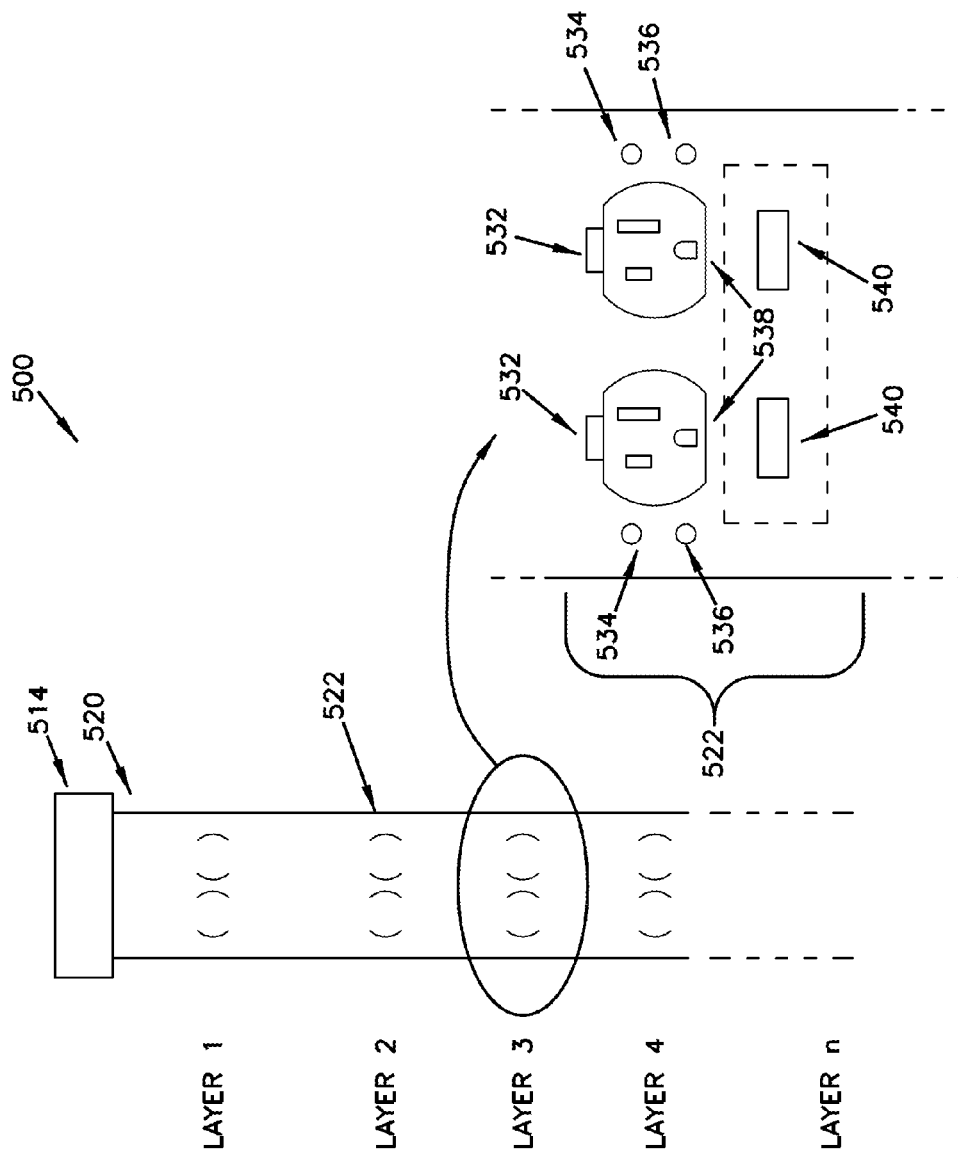
**FIG. 6**



**FIG. 7**



**FIG. 8**



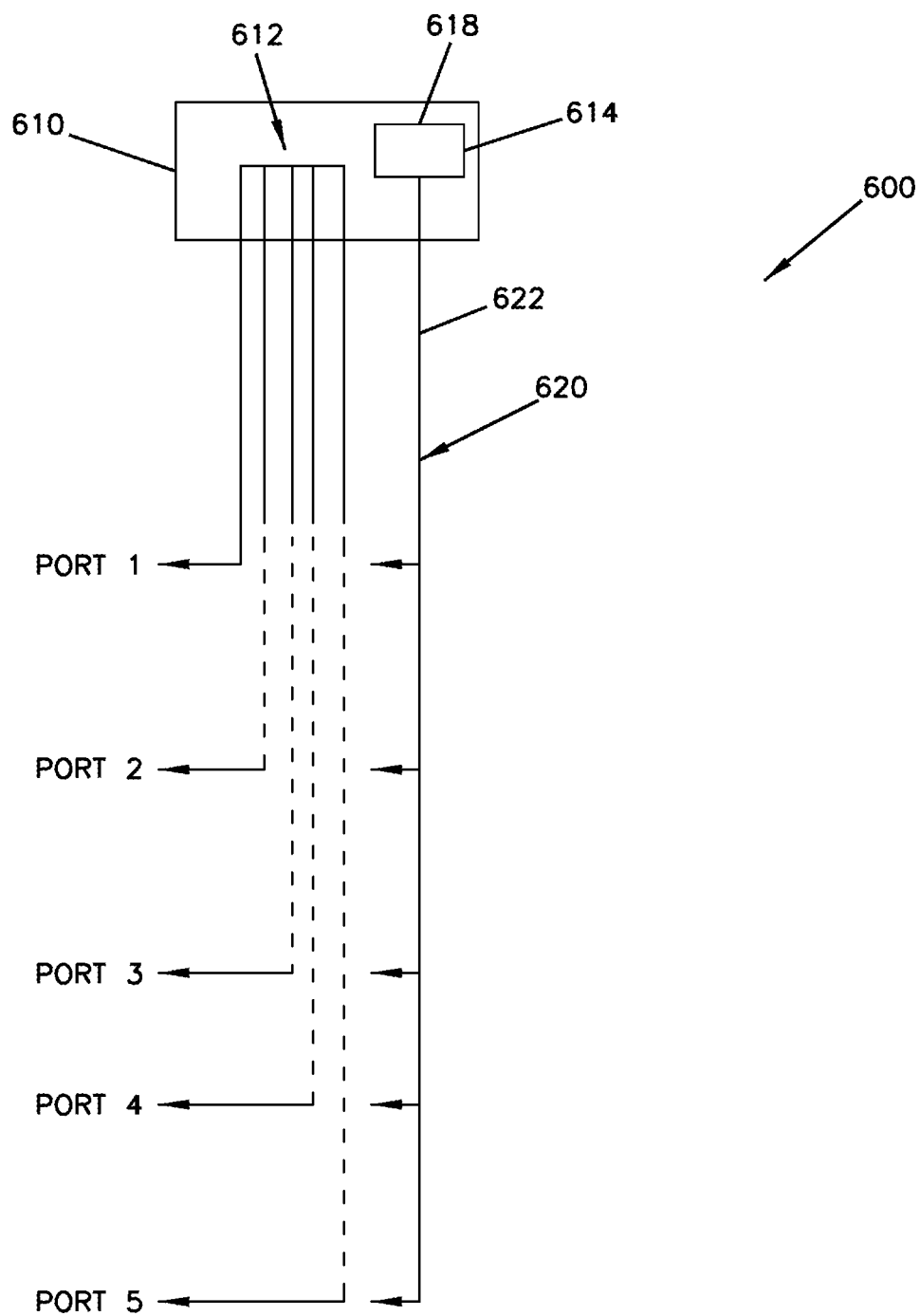
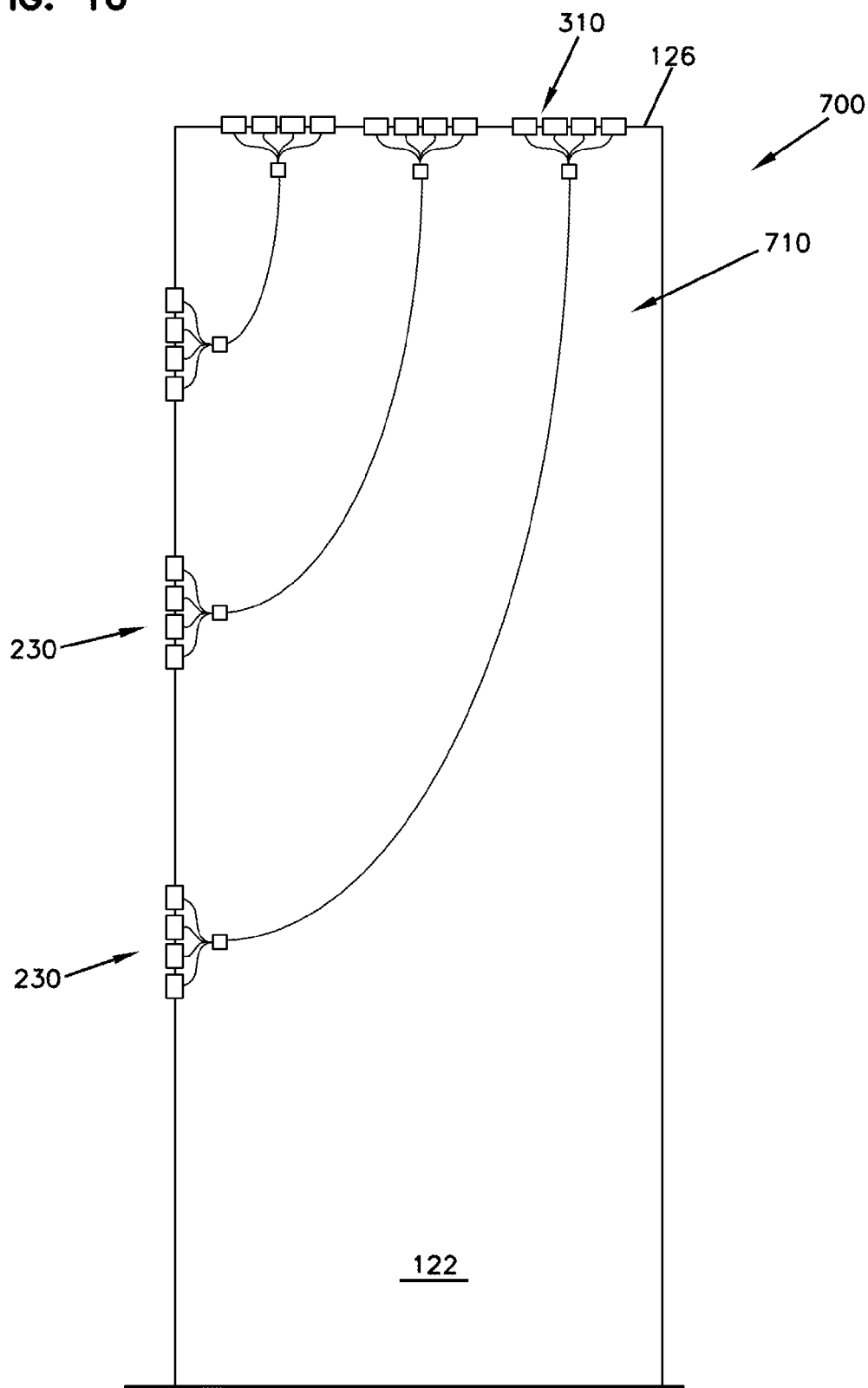
**FIG. 9**

FIG. 10





**FIG. 11**

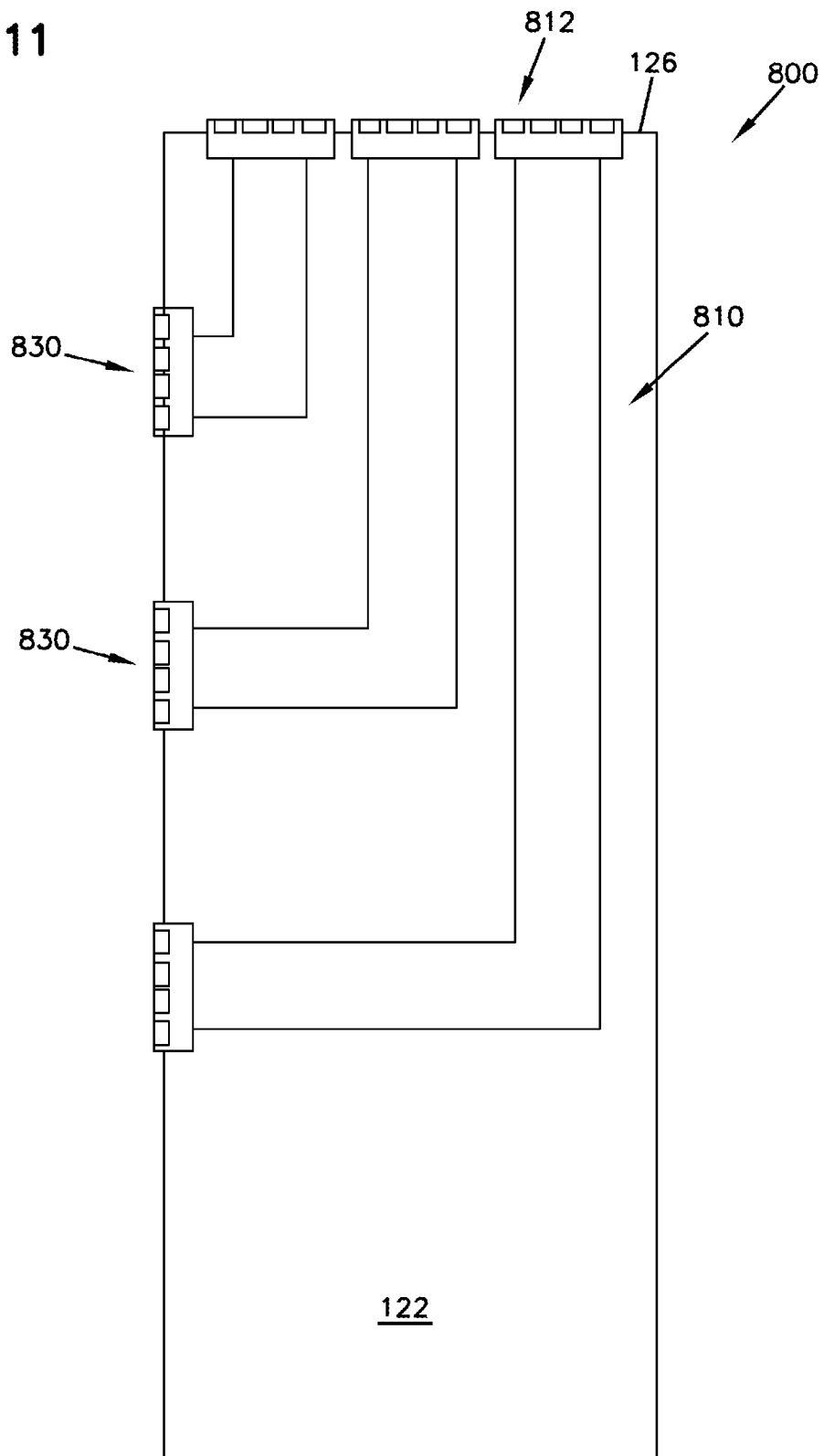
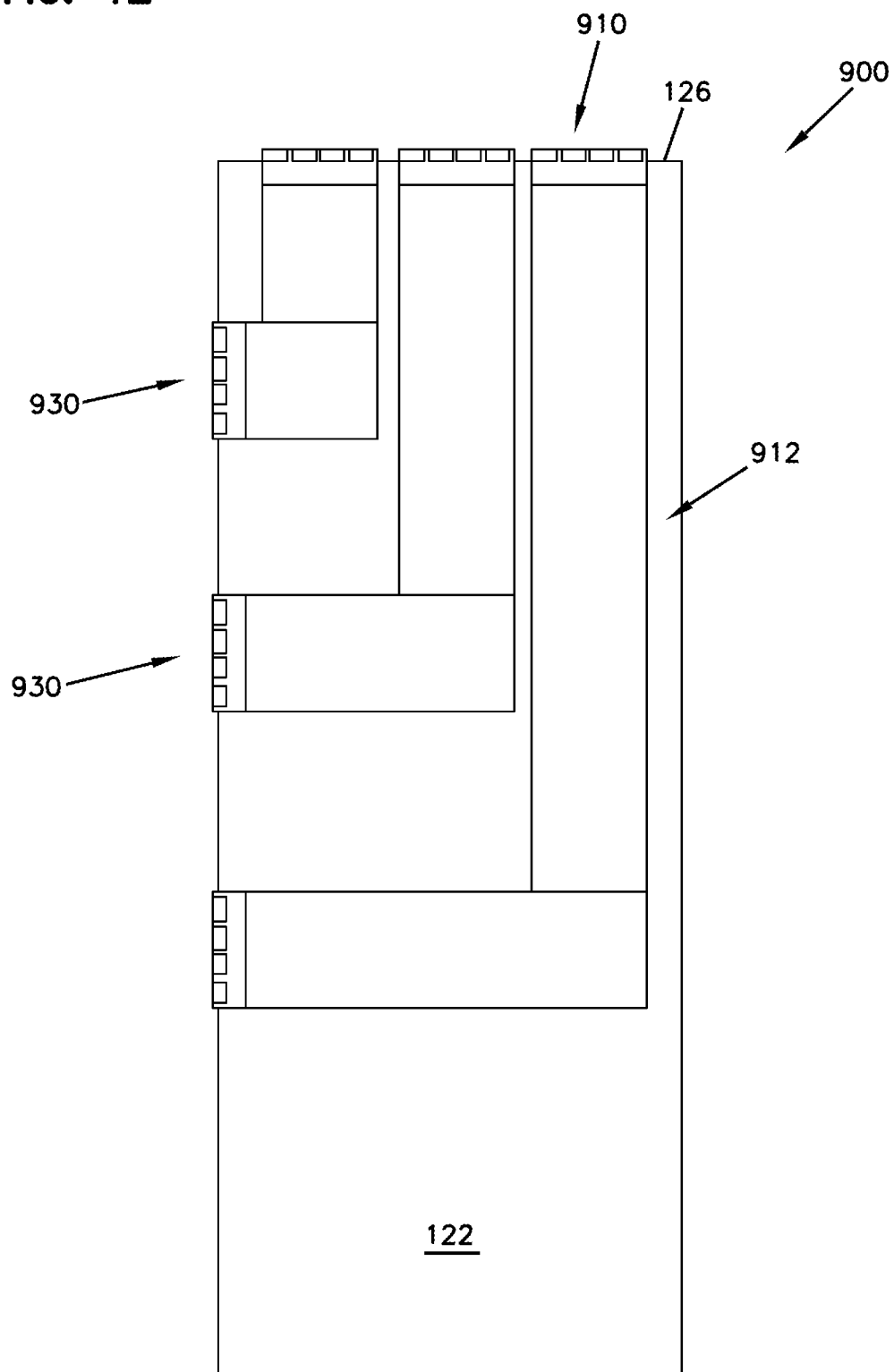


FIG. 12



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## TELECOMMUNICATIONS CABINET MODULARIZATION

### CROSS-REFERENCE TO RELATED APPLICATION

The present patent application claims the benefit of U.S. Provisional Patent Application Ser. No. 61/670,414, filed Jul. 11, 2012, which application is hereby incorporated by reference in its entirety.

### BACKGROUND

Telecommunications cabinets are used to hold equipment used in fiber optic and electrical networks. The equipment can be used to split and switch connections between origins and terminations. The equipment can perform other functions as well, such as to add power in Power-Over-Ethernet networks.

Fiber optic cables are typically run into and out of the cabinet to terminate with the equipment in the cabinet. Further, jumper cables can be used to make connections between different equipment within the cabinet. Excess cable can be looped and housed within the cabinet until needed. Heat generated by the equipment can be significant within the cabinet. The amount of cable run within the cabinet can disrupt cooling, thereby exacerbating the heating problems.

### SUMMARY

In one aspect, an example telecommunications cabinet includes: an enclosure including sidewalls extending between a bottom of the enclosure and a top of the enclosure to define an interior of the enclosure; telecommunications equipment disposed within the interior of the enclosure; and a data distribution arrangement disposed on one of the sidewalls within the interior of the enclosure.

In another aspect, a telecommunications cabinet includes: an enclosure including sidewalls extending between a bottom of the enclosure and a top of the enclosure to define an interior of the enclosure; telecommunications equipment disposed within the interior of the enclosure; an optical flexible foil cable disposed on one of the sidewalls within the interior of the enclosure, wherein the optical flexible foil cable is formed from a flexible polycarbonate material; wherein the optical flexible foil cable extends from the top of the enclosure through one of the sidewalls towards the bottom.

In yet another aspect, a method of distributing cables in a telecommunications cabinet includes: providing an enclosure including sidewalls extending between a bottom of the enclosure and a top of the enclosure to define an interior of the enclosure; positioning telecommunications equipment within the interior of the enclosure; and running a cable from the top of the enclosure, through the sidewalls within the interior of the enclosure, and to the telecommunications equipment.

### DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front view of an example telecommunications cabinet.

FIG. 2 is a perspective view of example cabling provided within the cabinet of FIG. 1.

FIG. 3 is a schematic view of example cabling provided within the cabinet of FIG. 1.

FIG. 4 is a schematic view of an example top wall of the cabinet of FIG. 1.

FIG. 5 is a front view of a portion of the cabinet of FIG. 1.

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FIG. 6 is a side view of example cabling provided within the cabinet of FIG. 1.

FIG. 7 is a side view of example cabling provided within the cabinet of FIG. 1.

FIG. 8 is a side view of example cabling provided within the cabinet of FIG. 1.

FIG. 9 is a side view of example cabling provided within the cabinet of FIG. 1.

FIG. 10 is a side view of another example telecommunications cabinet.

FIG. 11 is a side view of another example telecommunications cabinet.

FIG. 12 is a side view of another example telecommunications cabinet.

### DETAILED DESCRIPTION

The present disclosure is directed towards configurations for cabinets for telecommunications equipment. Although not so limited, an appreciation of the various aspects of the present disclosure will be gained through a discussion of the examples provided below.

FIGS. 1-5 illustrate one example embodiment for a telecommunications cabinet 100. In this example, the cabinet 100 includes a top wall 126, a bottom wall 128, and side walls 122, 124. A front wall (not shown) is also typically included so that the cabinet 100 provides an enclosed environment for telecommunications equipment.

In the example shown, telecommunications equipment 132, 134, 136 is provided within the cabinet 100. The equipment 132, 134, 136 can perform various tasks, such as splitting and/or routing optical and electrical connections from an origin to a destination. The equipment 132, 134, 136 can also perform such tasks as injecting power in a Power-Over-Ethernet environment. Other configurations are possible.

The telecommunications equipment 132, 134, 136 must be connected with a plurality of cables (fiber and/or electrical) to perform these functions. In this example, cables 104, 106 are routed from a fiber guide system 102 located above the cabinet 100. The cables 104, 106 are terminated at the top wall 126 of the cabinet 100.

As shown in FIG. 4, the top wall 126 includes modules 310, 314 with a plurality of ports 312 provided therein. Each of the ports 312 can terminate a fiber and/or electrical connection. The ports 312 can be used to make connections with the equipment 132, 134, 136 located within the cabinet 100, as described further below. The ports 312 can provide data and/or power to the equipment 132, 134, 136.

In one example, the modules 310, 314 are equipped with connection point identification technology (CPID) so that information contained in integrated circuit boards on the connectors connected to the modules 310, 314 is communicated to the equipment 132, 134, 136. One example of such CPID technology is the Quareo Technology provided by TE Connectivity of Berwyn, Pa.

In this example, the ports 312 can accept a variety of connectors. For example, fiber connectors can include an LC connector, although other connector types can be used. For example, in alternative embodiments, SC, MU, or LX.5 connectors can be used, such as that illustrated in U.S. Pat. No. 6,629,782.

The top wall 126 also includes ports 320, 322, 324, 326 that perform various other functions. In this example, the ports 320, 322 are power ports that connect with electrical cables to provide power to the equipment 132, 134, 136 within the cabinet 100.

The ports **324**, **326** are optical CPID ports that allow the cabinet **100** to be connected with other equipment, such as other cabinets of similar configuration. In this example, the cabinet **100** can be connected to a network having various configurations. For example, wired to other cabinets to provide interconnections therebetween. In another example, each cabinet can be wired to a switch matrix or patch panel to provide connectivity between cabinets.

Referring to FIGS. 1-3 and 5, the side walls **122**, **124** define passages **366** through which cabling **210** is run from the top wall **126** to the equipment **132**, **134**, **136** within the cabinet **100**. In example embodiments, the sidewalls **122**, **124** can be formed of two or more panels **125**, **127** that together form the passage **366** therethrough. The passage **366** can be partially and/or completely enclosed as the side walls **122**, **124** extend from the top wall **126** to the bottom wall **128**. Other configurations can be used to form the passage **366**. For example, in alternative embodiments, the passage **366** can be formed by other structures, such as beams with hollow interiors that are used to form portions of the side walls **122**, **124**.

Specifically, cables that originate from the modules **310**, **314** and ports **320**, **322**, **324**, **326** on the top wall **126** are run through the side walls **122**, **124**. In this example, the cabling can be a dense-type cabling, such as multi-mode and/or single mode fibers that have been embedded in a flexible foil structure. The foil structure can be made of various materials, such as a polycarbonate or a polyimide film, such as Kapton® polyimide film made by DuPont of Wilmington, Del. The foil allows for increased density when running a plurality of fibers while minimizing heat.

The cabling **210** is terminated along the side walls **122**, **124** at modules **220**, **230** that include ports **222**, **232**. The modules **220**, **230** can be of different types. For example, in this illustration, the port **222** on the module **220** is an MTP port, and the ports **232** on the module **230** are LC ports. Other configurations are possible.

Short jumper cables **123**, **143**, **144** can be connected from the modules **220**, **230** to ports located on the equipment **132**, **134**, **136** within the cabinet **100**. By optimizing (i.e., minimizing) the size of the jumper cables **123**, **143**, **144**, any slack within the cabinet is minimized. For example, the jumper cables **123**, **143**, **144** can be provided in different sizes so that the correct size can be used to route a jumper cable from a particular port on the side wall **122**, **124** to a particular port on the equipment **132**, **134**, **136**. In this manner, excess cable within the cabinet **100** is minimized.

In addition to running fiber through the side walls **122**, **124**, electrical cabling can also be provided through the side walls **122**, **124**. For example, electrical wires providing data and/or power can be run through the side walls **122**, **124** to terminations within the cabinet **100**.

Referring now to FIGS. 6 and 7, examples of the cabling **210** are shown. In FIG. 6, the cabling **210** includes the foil **372** in which optical fibers **374** are embedded. The foil **372** is flexible so that it can be positioned within the passages **366** to run from the top wall **126** to the bottom wall **128**. The foil **372** expands at the top to provide connections with the modules located at the top wall **126**. The foil **372** tapers into a more compact structure as the foil extends from the top wall **126** to allow for a greater density of cabling within the passages **366**.

In FIG. 7, an alternative configuration for the cabling is shown. In this example, circular cables **510** are fed into a convex foil **512** that is extended through the passages **366**. Other configurations are possible. Further, as noted previously, the foil can be used to carry both data and/or power.

For example, referring now to FIG. 8, an example flat power cable **500** is shown. The cable **500** is configured to be run within the passages **366** on the side walls **122**, **124**.

The cable **500** includes a module **514** that is positioned at the top wall **126** so that external cabling can be connected thereto. A flat cable **520** extends from the module **514**. In this example, the flat cable **520** is a multi-layered cable wrapped in a polymeric housing. Multiple wires can be run there-through while maintaining optimal density and thermal characteristics.

The cable **520** is terminated at a plurality of connections **522**. In the example shown, one or more of the connections **522** includes a port interface **532**, such as a Quareo CPID interface shown in FIG. 8. The connection **522** also includes indicator lights **534**, **536** for each electrical outlet **538**. In this example, the lights **534**, **536** are LEDs, with the light **534** indicating voltage within specified limits (e.g., for a Power-Over-Ethernet implementation) for the outlet **538**, and the light **536** indicates that the electrical outlet **538** is active (e.g., by sensing a current at the outlet). Each outlet **538** can also include a removable fuse **540**.

Referring now to FIG. 9, another example cable **600** is shown. The cable **600** provides both control and monitoring on the ports 1-5. Specifically, the cable **600** includes a control module **614** that communicates on a wire **622**. The control module **614** can function to provide control and monitoring of the ports, such as CPID, LED signaling, and current sensing. A power bus **612** provides power to each of the ports. The wire **622** and the bus **612** are both run through a flexible foil **620** made of a material like Kapton® polyimide film.

In example embodiments, the control module **614** can include various logical components. For example, the control module **614** can include a microprocessor to control monitoring of the network. The control module **614** can include storage and one or more removable storage devices (e.g., an SD Card port) that allows for event-related storage. The control module **614** can include communications circuitry that allows the control module **614** to communicate with the remainder of the network using Ethernet.

Each example port can also include enhanced functionality, including providing power in the Power-Over-Ethernet implementations. A microprocessor, such as a 16-bit DSP, can also be provided to perform functions like voltage and current sensing at the port. Other configurations are possible.

Referring now to FIG. 10, another example telecommunications cabinet **700** is shown. The cabinet **700** is similar to the cabinet **100** described above. However, the cabling **710** run within the side walls **122**, **124** of the cabinet **700** includes MPO cables that extend from the modules **310** in the top wall **126** to modules **230** in the side walls **122**, **124**. The modules **230** include LC ports, so that data that is transmitted from ports in the modules **310** is terminated in the LC ports in the modules **230**. The cabling **710** can be provided on a single plane to allow for maximization of air flow.

In alternative designs, electrical cables can be run. For example, the cabling could be MRJ21 cables that extend from the modules **310** in the top wall **126** to modules **230** in the side walls **122**, **124**. The modules **230** could include RJ45 ports, so that data is transmitted from ports in the modules **310** is terminated in the RJ45 ports in the modules **230**.

Similarly, in FIG. 11, a telecommunications cabinet **800** includes modules **812** formed of rigid printed circuit boards (PCBs) with jacks attached thereto. Flexible PCB cabling **810** extends from the modules **812**, through the side walls **122**, **124**, to modules **830**. The modules **830** are again formed of rigid PCB boards having jacks attached thereto. In this

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example, the jacks on the modules **812** are MRJ21 jacks, and the jacks on the modules **830** are RJ45 jacks.

In yet another embodiment shown in FIG. **12**, an example telecommunications cabinet **900** includes modules **910**, **930** and cabling **912**, all formed of rigid PCB board. Data is electrically transmitted to/from the modules **910**, **930**. The rigid PCB board extends through the side walls **122**, **124**. Other configurations are possible.

There can be various advantages associated with the configurations described herein. For example, by providing the terminations at the outside of the cabinet, the amount of cabling run within the cabinet can be controlled to maximize thermal properties, such as cooling. Further, routing the cables through the side walls allows the cabinets to be “pre-wired” during assembly of the cabinets, thereby further optimizing cabling within the cabinets.

The routing of the cables in this manner also increases the density of the cabling that can be provided. The ribbon-like cabling allows for multiple layers of cable to be stacked, increasing the density of the cabling. Use of jumper cables of specified lengths also minimizes excess cabling (e.g., slack) within the cabinet, enhancing the thermal properties of the cabinet.

Further, termination of the ports outside of the cabinet minimizes the need to access the internal space of the cabinet for modifications, such as moves, adds, and changes (MAC). This results in a reduction for the need of patch panels and optimizes rack space for further equipment to be stored within the cabinet.

Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.

What is claimed is:

1. A telecommunications cabinet, comprising:
  - an enclosure including an exterior sidewall extending between a bottom of the enclosure and a top of the enclosure to define an interior of the enclosure, a first side of the exterior sidewall forming an outer perimeter of the telecommunications cabinet, and a second side of the exterior sidewall forming the interior;
  - telecommunications equipment disposed within the interior of the enclosure;
  - an interior sidewall extending along and spaced apart from the exterior sidewall, with a space being formed between the interior sidewall and the second side of the exterior sidewall; and
  - a data distribution arrangement disposed within the space formed between the interior sidewall and the exterior sidewall of the enclosure, wherein the data distribution arrangement includes an optical flexible foil cable.
2. The telecommunications cabinet of claim 1, wherein the optical flexible foil cable is formed from a flexible polycarbonate material.
3. The telecommunications cabinet of claim 1, wherein the optical flexible foil cable is formed from a flexible Kapton material.
4. The telecommunications cabinet of claim 1, wherein the optical flexible foil cable extends from the top of the enclosure through one of the sidewalls towards the bottom.
5. The telecommunications cabinet of claim 1, wherein the telecommunications equipment includes active telecommunications equipment.

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6. The telecommunications cabinet of claim 5, wherein the active telecommunications equipment includes an optical switch.

7. The telecommunications cabinet of claim 1, further comprising:

- at least one electrical port for receiving a power feed defined at the top of the enclosure; and
- a power distribution arrangement disposed on one of the sidewalls within the interior of the enclosure, the power distribution arrangement being electrically coupled to the electrical port at the top of the enclosure.

8. The telecommunications cabinet of claim 7, wherein the power distribution arrangement includes an electrical ribbon cable.

9. The telecommunications cabinet of claim 1, wherein the data distribution arrangement includes one or more electrical conduits over which data is transmitted.

10. The telecommunications cabinet of claim 9, wherein the electrical conduits include a printed circuit board.

11. The telecommunications cabinet of claim 10, wherein the printed circuit board is a flexible printed circuit board.

12. The telecommunications cabinet of claim 1, further comprising:

- the optical flexible foil cable disposed within the space, wherein the optical flexible foil cable is formed from a flexible polycarbonate material;
- wherein the optical flexible foil cable extends from the top of the enclosure through one of the sidewalls towards the bottom.

13. The telecommunications cabinet of claim 12, wherein the optical flexible foil cable is formed from a flexible Kapton material.

14. The telecommunications cabinet of claim 12, wherein the telecommunications equipment includes an optical switch.

15. The telecommunications cabinet of claim 1, further comprising:

- at least one electrical port for receiving a power feed defined at the top of the enclosure; and
- a power distribution arrangement disposed on one of the sidewalls within the interior of the enclosure, the power distribution arrangement being electrically coupled to the electrical port at the top of the enclosure.

16. A method of distributing cables in a telecommunications cabinet, the method comprising:

- providing an enclosure including an exterior sidewall extending between a bottom of the enclosure and a top of the enclosure to define an interior of the enclosure;
- positioning telecommunications equipment configured to split connections within the interior of the enclosure;
- running a cable from the top of the enclosure, through a space formed between the exterior sidewall and an interior sidewall within the interior of the enclosure, wherein the cable is flexible and includes optical fibers for optical signals and one or more wires for power; and
- terminating the cable so that the optical fibers transmit optical data to the telecommunications equipment and the one or more wires deliver power to or from the telecommunications equipment.

17. The method of claim 16, wherein the telecommunications equipment includes active telecommunications equipment.

18. The method of claim 17, wherein the active telecommunications equipment includes an optical switch.